Australian greenhouse and energy policy context

Current Australian Government policy is to not to ratify the Kyoto Protocol, to which Australia is a signatory, on the basis that to do so at the present time is not in Australia's interests.

Nevertheless the Government has committed to developing domestic emissions abatement programs to meet Australia's assigned amount under the Protocol – most recent emissions projections indicate that Australia is "within striking distance" of achieving its Kyoto target of 108% of 1990 emissions in 2008-12 – and to further reduce Australia's emissions beyond the first commitment period.

This latter emphasis on the longer term is a key aspect of Australian climate change policy, which encompasses adaptation as well as abatement and has as a core requirement the need to maintain a strong and internationally competitive economy.

Australia's National Greenhouse Strategy embodies the need for greenhouse response to be integrated with other government commitments and to recognise Australia's national interests and circumstances. In regard to energy, these interests and circumstances have been summarised by the Coucil of Australian Governments (COAG – encompassing the federal and all state and territory governments) as follows:

- the energy sector underpins Australia's economic, environmental and social goals;
- competitively priced, reliable energy is key to the country's international competitiveness and living standard;
- the production and export of energy commodities contributes significantly to national wealth;
- Australia will remain substantially reliant on fossil fuels for the forseeable future.

While Australia does not currently have a formal national energy policy, COAG has agreed on the following energy policy objectives:

- Efficiency – encouraging efficient provision of relaible, competively priced energy services;
- Energy security – encouraging development of Australia's energy resources, technology and expertise;
- Environmental sustainability – mitigating environmental impacts of energy production, transformation, supply and use.

Towards this last objective, the Federal and state governments have initiated a number of measures to reduce greenhouse gas emissions from energy supply and use and encourage the development of cleaner fossil fuel generation technologies and renewable energy. These measures include:

- regulated measures, such as:

- the national Mandatory Renewable Energy Targets scheme that, through requirements on electricity retailers and other wholesale power purchasers, will result in an additional 9,500 GWh of generation from renewable and specified waste fuels by 2010 (this scheme is currently under review);
- the New South Wales (state) Greenhouse Gas Abatement Scheme which sets emissions benchmarks for electricity retailers and large-scale users, and aims to reduce emissions per head of state population by 7.27 tCO_2e by 2007; and
- the Queensland (state) 13% Gas Scheme, which requires electricity retailers and wholesale to source at 13% of their supply from gas fired generation from mid 2005.

- voluntary measures, such as:
  - the Greenhouse Challenge, under which enterprises and organsiations enter into agreements with the Federal Government to undertake and report on emissions abatement – almost all electricty supply businesses in Australia are signatories;
  - Generator Efficiency Standards, through which the Federal Government aims to move fossil fuel generation towards best preactice (identified under the scheme as 42% thermal efficiency on a HHV basis for coal based generation);
  - various GreenPower schemes and a Renewable Energy Action Agenda focussing mainly on electricity supply.
- industry support and research and development assistance, including Cooperative Research Centres (joint ventures between government, industry and research providers) on:
  - Coal in Sustainable Development, which incorprates research into current, transitional and future coal-based generation technologies;
  - Clean Power from Lignite, aimed at reducing the environmental impact of brown coal use;
  - Greenhouse Gas Technologies, investigating the technical and commercial feasibility of CO_2 capture from industrial systems and its storage in deep geological formations.

A recent review of the Australian energy market was critical of the range of different greenhouse-related measures impacting on the electricity and gas sectors, concluding that the targeting of policies at fuels and technologies rather than emissions, and a lack of coordination among the federal and state governments, had lead to inconsistency, high costs and heightened risk for investors. The review recommended that the federal and state governments replace a number of their separate schemes with a national, cross sectoral emissions trading scheme.

Notwithstanding this recommendation, the Federal Government does not propose to introduce such a national emissions trading regime. The Government has recently entered into bilateral Climate Change Action Partnerships (with the USA, Japan and the EU) which reflect its longer term focus on the further development of greenhouse science, emissions measurement and new abatement technologies.

COAL21

Although support for clean coal technology (CCT) development is an important component of Federal and several state government policies, Australia lacks a coherent national strategy for the development and uptake of CCTs. COAL21 is a recently announced joint industry-government initiative intended to develop such a strategy, with a particular emphasis on near zero emissions technology. Its aims include to:

- Create a national plan to scope, develop, demonstrate and implement near zero emissions coal-based electricity generation that will achieve major reductions in greenhouse gas emissions over time and maintain Australia's low cost electricity advantage.
- Facilitate the demonstration, commercialisation and early uptake of technologoies identified in the plan.
- Promote relevant Australia RD&D so that it can both build upon and make a unique contribution to international RD&D in the area.
- Provide a mechanism for effective interaction and integration with other international zero-emission coal initiatives.

COAL21 has just relased an issues paper for consultation with stakeholders on development of the proposed national plan for reducing emmissions from coal fired electricity – the paper is available at http://www.coal21.com.au. Following consultations with stakeholders during September and October 2003, a clean coal technology roadmap and actions plans wil be be developed for implementation from early 2004.

Australian coal fired power generation

Austtalia has 39 coal-fired power stations fuelled by bituminous coal (23), sub-bituminous coal (7) and lignite (9). Their combined generating capacity is about 30,000 MW, which represents about 70% of of total installed electricity generation capacity in Australia.

All of Australia's coal-fired stations are PF plants and most of them are subcritical, ranging in age from 45 years to one year. Their average age (excluding those less than five years old) is 27 years, and average thermal efficincy (all plants) is around 33% on a power sent out, HHV basis.

Australia's youngest coal-fired stations are superctritical, all of them located in the state of Queensland and with a total generating gapacity in excess of of 2000 MW.

Australia derives enormous benefits from the competiveness and relaibility of its coal-based electricity supply sector. It has attracted major energy intensive industries such as minerals mining and processing and pulp and paper, which contribute greatly to exports and import substitution.

Currently about half of Australia's total greenhouse gas emissions are from stationary energy, and of this about two-thirds is from electricity generation. Coal-based power generation accounts for about 80% of total electricity consumption and around 30% of Australia's total greenhouse gas emisions.

Emissions from the electricity sector have increased strongly over the last decade and will continue to increase. The Australian Bureau of Agricultural and Resource Economics (ABARE) forecasts electricity demand in Australia to increase by 2.35% per annum to 2020. Over this period, coal's share of generation is expected to decline to less than 70% - replaced mainly by gas and some non-hydro renewables – although black coal consumption for generation will nevertheless increase by an expected 1.6% per annum, and brown coal by 1% pa.

Costs of CO_2 reduction from Australian coal based generation

Two recent studies prepared for the Coopertive Research Centre for Coal in Sustainable Development provide indications of the costs (in terms of power generation costs) of reducing CO_2 emissions from Australian coal-fired electricty production through the application of advanced generation technologies for new and replacment plant.

N Dave & G Duffy (*Comparison of Advanced Power and Polygeneration Systems, June 2003*) compare the economics of power generation using conventional and advanced technologies (see Table 1). They conclude that:

- Currently available ultrasupercritical (USC) plant technology is superior to both conventional subcritical PF and conventional IGCC power technology in terms of both economics and emissions. USC emits around 20 kg/MWh less CO_2 and its short term marginal cost of generation is about AU 0.16 c/kWh less than conventional IGCC. (IGCC would, however have advantages over USC if CO_2 capture was integrated with the generation.)
- CO_2 emissions from 2nd generation IGCC plant (see Table 1) operating at 45.4% efficiency (HHV basis) would be about 10% lower than USC at an increase in generation costs of 6% (0.1c/kWh). Compared to curent subcritical PF plants, 2nd generation IGCC offers over 20% reduction in CO_2 emissions at around the same short run marginal cost of power production.
- Advanced 3rd generation IGCC technologies currently under development and likely to achieve net efficiencies approaching 50% (HHV), would have the same capital cost per kW installed as current subcritical plants, but would produce about 25% (200kg) less CO_2 per MWh. Further, the performance of these 3rd generation IGCC technologies is likely to improve further with the commercialisation of membrane based air separation units around 2010.

In the other study, *Options for Electricity Generation in Australia* (P Graham, N Dave, P Coombes, D Vincent & G Duffy – July 03) the authors examine the options for future electricity generation in Australia and determine the impact of those options in terms of their grenhouse gas emissions and costs. This was done by setting a range of greeenhouse gas emission targets out to 2050 and applying a cost minimising algorithm (ie. self-adjusting CO_2 penalty or permit price) to derive the market determined combination of technologies under each scenario. The result is a set of portfolios of electricity generation technology options associated with each scenario of emissions, electricity costs and CO_2 penalty.

Importantly, the analysis took account of the effects of endogenous as well as exogenous technological change on generation costs, and in regard to fossil fuel based

technologies, accounted for indirect fugitive greenhouse emissions in addition to those from generation.

Among the Australian emission profiles modelled were the following:

- Business as usual (BAU) – no emissions limitation;
- Emission stabilisation from 2012; and
- Emissions at 1990 levels by 2050.

The study also modelled a number of sensitivites in regard to aspects of electricity demand, gas supply and the feasibility of CO_2 capture and storage. Table 2 provides a summary of some of the findings for the base case only and the above emission scenarios.

Table 1 – Performance & costs of coal based power generation systems (A$ Dec 02)	**PF subcritical**	**PF USC**	**PF lignite subcritical**	**IGCC conventional**	**IGCC 2nd generation**	**IGCC 3rd generation**	**IGCC 3rd generation***	**CPFBC**
Net output (Mwe)	402	403	400	543	350	398	428	379
Net efficiency (%HHV)	37.6	41.8	28	40.2	45.4	49.7	49.1	47.0
Capital cost ($/kWe)	1023	1064	1300	1188	1165	895	1031	992
Fixed O&M cost (¢/kWh)	0.35	0.36	0.38	0.49	0.55	0.49	0.51	0.46
Fuel cost($/GJ)	1.0	1.0	0.4	1.0	1.0	1.0	1.0	1.0
SRMC (¢/kWh)	1.66	1.55	1.33	1.71	1.65	1.48	1.52	1.64
Capacity factor (%)	85	85	85	85	85	85	85	85
CO2 emissions (kg/MWh)	848	763	1210	793	702	641	649	678

PF USC – 300 atm/593^{o}C/593^{o}C/593^{o}C

IGCC conventional – O_2 blown; 1288 ^{o}C cold gas cleanup; 120 atm//538^{o}C/593^{o}C

ICCC 2nd generation - O_2 blown; 1400 ^{o}C ; hot gas cleanup; 120 atm//538^{o}C/593^{o}C

ICCC 3nd generation - air blown (tutbine air compresor/gasifier integration); 1430 ^{o}C ; hot gas cleanup; 120 atm//538^{o}C/593^{o}C

ICCC 3nd generation* - O_2 blown (turbine air compressor/ASU integration); 1430 ^{o}C ; hot gas cleanup; 120 atm//538^{o}C/593^{o}C

CPFBC – circulating pressuriused fluidised bed; 1400 ^{o}C; 160 atm/566 ^{o}C/538 ^{o}C

Table 2 – Generation technology mixes for different emissions scenarios (levels, penalties and power prices) – Base Case	Share of Australian electricity generation			
	2000	2050		
		Business as usual	CO_2 stabilisation from 2012	1990 emissions by 2050
Black coal subcritical PF	59%	8%	12%	10%
Black coal USC	0%	55%	10%	0%
Black coal IGCC	0%	0%	0%	0%
Black coal IGCC with CCS[(a)]	0%	0%	29%	38%
Brown coal subcritical PF	25%	1%	1%	0%
Brown coal IGCC	0%	19%	0%	0%
Brown coal IGCC with CCS	0%	0%	16%	16%
Gas simple cycle	5%	5%	1%	2%
Gas combined cycle	2%	2%	22%	4%
Hydro	8%	4%	4%	4%
Non-hydro renewables	1%	6%[(b)]	6%	26%
Wholesale power price ($/MWh)	$34.40	$38.3[(c)]	$49.60[(c)]	$56.20[(c)]
CO2 penalty ($/t$CO_2$e)	$0	$0	$19.70[(c)]	$69.00[(c)]

(a) CO_2 capure and storage

(b) Non-hydro renewables uptake under BAU due to the Federal Government's Mandatory Renewables Energy Targets scheme.

(c) Prices and CO_2 penalties for 2050 are volume weighted averages for the period 2000-50.